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Measurements of 3-D Circulation and Dispersion in Skagit Bay from Lagrangian Drifters

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14. ABSTRACT

Several River Drifters (RD) deployments were made during this past year. Whilst the target was to sample the Tijuana river plume during major rain events, the ranty of the latter hindered our efforts. The deployments of 01/13/2009 and 01/14/2009 where coordinated with the other participants in the project.
To gain further operational experience an array of two river drifters was deployed during a storm surge at a river estuary at Lido di Dante (Italy) in April 25-27, 2009.

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FINAL TECHNICAL REPORT FOR:

"Measurements of 3-D Circulation and Dispersion in Skagit Bay from Lagrangian Drifters"

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Contents

Long Term Goals

The long term goal of this proposal is to study the hydrodynamics of the near-shore environment using novel instrumentations and techniques. Special focus is on the spatial structures of the flow that dominate erosion, transport and dispersion processes. We also aim to provide a methodology to test the validity of numerical simulations of coastal flows, the predictions of which are highly sensitive to the large scale initial conditions and model output verification is

required.

Objectives

The first objeetive of the program was to develop an effieient sampling scheme to measure the flow in the shallow estuarine and coastal environments and to provide the partners of the projeet with three-dimensional eireulation data and horizontal dispersion estimates of the partieles in the surfaee flow. Our self-training period resulted in the aequisition of the operational experienee to manage an array of RD as well as identifying the optimal set of mission parameters of the RD in different environmental conditions.

The second objective was to measure the flow within the plume of the Tijuana River as well as the eirculation in adjaeent coastal sea.

The third objeetive was to redesign and re-build the firmware of the RD to add new eapabilities to the instrument, sueh as two-way eommunieation, deployment and reeovery modes, power saving mode and high frequeney GPS.

Approach

To aehieve our first objeetive we targeted RD deployments during signifieant rain events at the mouth of the Tijuana River, off La Jolla, and in northern Italy.

To aehieve our seeond objeetive we eoordinated our deployment efforts with other projeet partieipants, both from the numerieal modeling eommunity and from the observational eommunity.

To aehieve the third objeetive we replaeed the RD controller originally designed by Clearwater Inc., and we reprogrammed a Persistor mierocomputer to manage all the RD functions.

Work Accomplished

Several River Drifters (RD) deployments were made during this past year. Whilst the target was to sample the Tijuana river plume during major rain events, the rarity of the latter hindered our efforts.

The table below eontains a list of deployments in the San Diego area.

Date	Loeation	# of RD deployed	duration
12/16/2008	Tijuana river	1	2 hours
01/13/2009	La Jolla	4	2.5 hours
01/14/2009	La Jolla	4	3.5 hours

02/18/2009	Tijuana river	4	2.4 hours
12/08/2009	Tijuana river	2	3.5 hours
12/12/2009	Tijuana river	2	1.6 hours
1/25/2010	Tijuana river	2	2.9 hours
1/27/2010	Tijuana river	3	1.2 hours

The deployments of 01/13/2009 and 01/14/2009 where coordinated with the other participants in the project.

To gain further operational experience an array of two river drifters was deployed during a storm surge at a river estuary at Lido di Dante (Italy) in April 25-27, 2009.

Results

The main results are:

1) RD's operated near the surf zone. We observed that most, if not all, of the rain events were associated with storm conditions (high waves and winds). Small boats were not suitable for operations in such situations and several cancellations occurred. We did operate two jet sky's for our Tijuana River plume observations;
2) Several ADCP and bottom pinger sampling schemes were adopted. We concluded that for most applications a 1s sampling (as logged internally by the ADCP module) was appropriate in light of a more flexible post-processing approach. The RD firmware was then modified to allow 1s sampling of all the sensors. The two-way communication capability does allow us to turn on and off the ADCP.
3) The RD mechanical design was improved: the sails were fitted with zippers, rechargeable batteries implemented, need for extra buoyancy in extremely shallow water assessed, external, add-on, salinity sensors implemented;
4) The RD computer was rebuilt.
5) Results of runs made available to numerical modeling community for consistency checks of their numerical simulations (Figure 1)

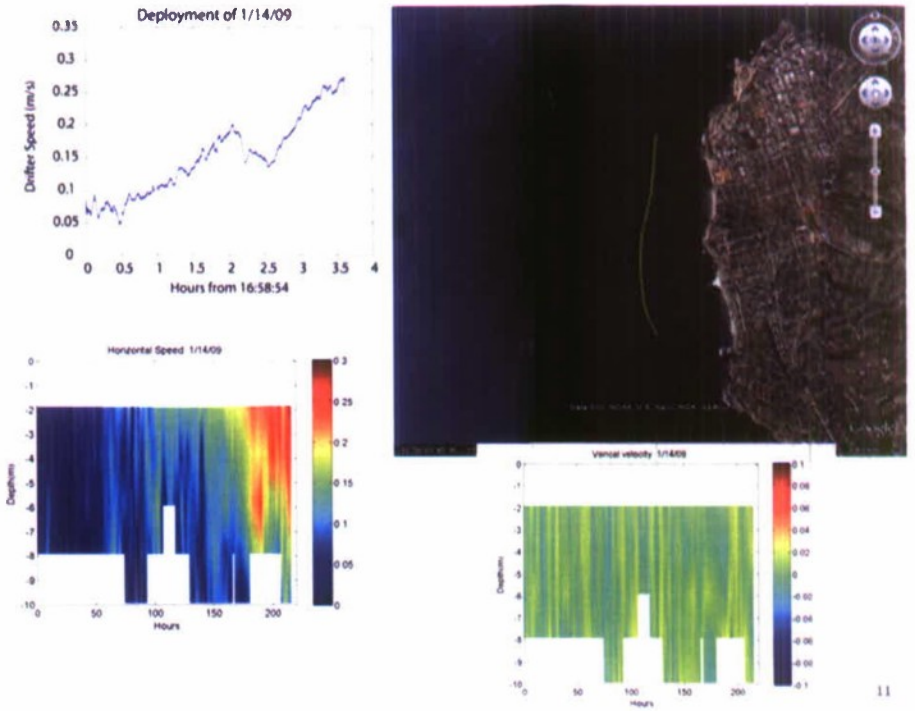

Figure 1: Example of data collected with one RD on January 14, 2009, off La Jolla, California. This rune was performed during the acquisition of the boundary conditions for the Deltares model from a variety of sensors.

6) The plume trajectories (see example in figure 2) and the measured vertical shear are being used to investigate the controlling hydrodynamics of the plume, and a manuscript for a refereed journal is in preparation.

Impact/Applications

The drifter data were placed on a SIO website for the use of the Tijuana Plume research group (http://tjplumexp.ucsd.edu/). This research program did investigate ways to operate efficiently multiple arrays of RD and CODE drifters. For the NAVY such methodology is crucial for application of these instruments for both tactical operations and for testing and initialization of hydrodynamic predictive models of littoral conditions.

Figure 2: tracks of a River Drifter advected by the Tijuana River plume during the high discharge event of February 18, 2009.

Transitions

None to date

Related Projects

The Global Drifter Program

Publications from This Grant

'Modeling the controlling hydrodynamics of a coastal plume. part 2: transport and mixing', in preparation for Journal of geophysical Research.